

## AUTHORS INDEX

ADAMS, C. M., JR., M. C. FLEMINGS and H. F. TAYLOR — Solidification and Riser of Gray Iron Castings .....	369
AFS MALLEABLE DIVISION CONTROLLED ANNEALING COMMITTEE — Malleable Iron Microstructures Effect and Cause .....	166
AHEARN, P. J., H. M. GREEN and J. ZOTOS — Ductile High Strength Titanium Castings by Induction Melting .....	225
ANTES, H. W., J. T. NORTON and R. E. EDELMAN — Foundry Characteristics of a Rammed Graphitic Mold Material for Casting Titanium .....	135
ASCHOFF, W. A. and D. H. BLAIR — Problems Encountered in Casting Reactive Metals .....	257
AUSMUS, S. L., E. D. CALVERT and F. W. WOOD — A Casting Technology for Reactive Metals .....	354
BAER, W. H., M. GLASSENBERG and A. H. HESSE — Occurrence and Elimination of Leakage in a Gun Metal Casting .....	231
BAKER, C. R., G. H. BASCOM and W. C. TRUCKENMILLER — Evaluation of Shell Molding Process Capability .....	81
BARLOW, T. E. and H. W. DIETER — Hot Deformation of Molding Sand .....	7
BASECOM, G. H., W. C. TRUCKENMILLER and C. R. BAKER — Evaluation of Shell Molding Process Capability .....	81
BLAIR, D. H. and W. A. ASCHOFF — Problems Encountered in Casting Reactive Metals .....	257
BOVARNICK, B. and F. C. QUIGLEY — Sintered Alumina Molds for Investment Casting of Steels .....	247
BRAMMER, W. N. — Melting Practice for Aluminum Casting Alloys .....	497
BRUCE, L. J. and G. A. BROUGHTON — Die and Permanent Mold Casting of Nonferrous Metals in the United Kingdom .....	466
BROOKS, M. E. and J. G. HOUSE — Induction Melting in a Magnesium Sand Foundry .....	87
BROUGHTON, G. A. and L. J. BRUCE — Die and Permanent Mold Casting of Nonferrous Metals in the United Kingdom .....	466
BUKOWSKI, A., E. A. LANGE and N. C. HOWELLS — Cast Age-Hardenable Austenitic Steels .....	519
CAINE, J. B. and C. E. MCQUISTON — The Theoretical Concepts of the Packing of Small Particles .....	36
CALVERT, E. D., F. W. WOOD and S. L. AUSMUS — A Casting Technology for Reactive Metals .....	354
CLARK, L. L., W. ROSTOKER and A. H. MURPHY — Improvement of Castings by Press Forging .....	105
COLLIGAN, G. A., L. H. VAN VLACK and R. A. FLINN — The Effect of Temperature and Atmosphere on Iron-Silica Interface Reaction .....	452
DAVIS, H. M. and A. PAL — On the Release of Hydrogen from Molten Aluminum .....	301
DAVIS, M. V. and R. V. SCALCO — Foundry Practice for Sand Casting Commercially Pure Aluminum .....	238
DAWSON, J. V. and L. W. L. SMITH — Gases in Cast Iron with Special Reference to Pickup of Hydrogen in Sand Molds .....	17
DEROSS, A. B. — High Strength Aluminum Alloy X357 Properties and Aging Practice .....	480
DICKERSON, R. F. and A. W. HARE — A Method of Casting Radiator-type Fuel Elements for A Nuclear Reactor .....	210
DIETER, H. W. and T. E. BARLOW — Hot Deformation of Molding Sand .....	7
DONOHO, C. K. and J. F. ELLIS — Magnesium Content and Graphite Forms in Cast Iron .....	203
DOST, F. J. and G. P. RIBAR — Prevention by the Ounce .....	433
DREHER, G. K. — How Patternmakers can Help to Sell Castings .....	583
ECKEL, E. J. — A study of the Ferritization of Nodular Iron .....	151
EDELMAN, R. E., H. W. ANTES and J. T. NORTON — Foundry Characteristics of a Rammed Graphitic Mold Material for Casting Titanium .....	135
ELLIS, J. F. and C. K. DONOHO — Magnesium Content and Graphite Forms in Cast Iron .....	203
EVANS, E. B. and J. F. WALLACE — Risering of Gray Iron Castings .....	49
FAIRFIELD, H. H. and J. A. ORTIZ — Some Factors Affecting the Toughness of Mild Steel Castings .....	344
FAUSEL, C. E. — Your Foundry and Preventive Maintenance .....	446
FEINBERG, I. J. and J. D. GRIMSLY — Tensile Properties of Microshrinkage-Graded AZ-63 Magnesium Alloy .....	409
FITTERER, G. R. and S. A. PRUSSIN — Some Requirements for Successful Fluidity Testing .....	143
FLEMINGS, D. — The Controlled-Slag Hot-Blast Cupola .....	113
FLEMINGS, M. C., H. F. TAYLOR and C. M. ADAMS, JR. — Solidification and Riser of Gray Iron Castings .....	369
FLEMINGS, M. C., H. F. TAYLOR and E. M. PASSMORE — Fundamental Studies on Effects of Solution Treatment, Iron Content and Chilling of Sand Cast Aluminum-Copper Alloy .....	96
FLEMINGS, M. C., H. F. TAYLOR and S. Z. URAM — Effect of Pressure During Solidification on Microporosity in Aluminum Alloys .....	129
FLEMINGS, M. C., R. W. STRACHAN, E. J. POIRIER and H. F. TAYLOR — Performance of Chills on High Strength Magnesium Alloy Sand Castings of Various Section Thicknesses .....	336
FLEMINGS, M. C., R. W. STRACHAN, E. J. POIRIER and H. F. TAYLOR — Rigging Design of High Strength Magnesium Alloy Castings .....	241
FLINN, R. A. and C. R. MIELKE — Effects of Foundry Variables upon Porosity of 85-5-5-5 Bronze .....	391
FLINN, R. A., G. A. COLLIGAN and L. H. VAN VLACK — The Effect of Temperature and Atmosphere on Iron-Silica Interface Reaction .....	452
GEARY, E. A. — Pattern Standards for Practical Foundry Usage .....	556
GERTSMAN, S. L. and A. E. MURTON — A Literature Review of Metal Penetration .....	1
GLASSENBERG, M., A. H. HESSE and W. H. BAER — Occurrence and Elimination of Leakage in a Gun Metal Casting .....	231
GREEN, H. M., J. ZOTOS and P. J. AHEARN — Ductile High Strength Titanium Castings by Induction Melting .....	225

## AUTHORS INDEX

ADAMS, C. M., JR., M. C. FLEMINGS and H. F. TAYLOR — Solidification and Riser of Gray Iron Castings .....	369
AFS MALLEABLE DIVISION CONTROLLED ANNEALING COMMITTEE — Malleable Iron Microstructures Effect and Cause .....	166
AHEARN, P. J., H. M. GREEN and J. ZOTOS — Ductile High Strength Titanium Castings by Induction Melting .....	225
ANTES, H. W., J. T. NORTON and R. E. EDELMAN — Foundry Characteristics of a Rammed Graphitic Mold Material for Casting Titanium .....	135
ASCHOFF, W. A. and D. H. BLAIR — Problems Encountered in Casting Reactive Metals .....	257
AUSMUS, S. L., E. D. CALVERT and F. W. WOOD — A Casting Technology for Reactive Metals .....	354
BAER, W. H., M. GLASSENBERG and A. H. HESSE — Occurrence and Elimination of Leakage in a Gun Metal Casting .....	231
BAKER, C. R., G. H. BASCOM and W. C. TRUCKENMILLER — Evaluation of Shell Molding Process Capability .....	81
BARLOW, T. E. and H. W. DIETER — Hot Deformation of Molding Sand .....	7
BASECOM, G. H., W. C. TRUCKENMILLER and C. R. BAKER — Evaluation of Shell Molding Process Capability .....	81
BLAIR, D. H. and W. A. ASCHOFF — Problems Encountered in Casting Reactive Metals .....	257
BOVARNICK, B. and F. C. QUIGLEY — Sintered Alumina Molds for Investment Casting of Steels .....	247
BRAMMER, W. N. — Melting Practice for Aluminum Casting Alloys .....	497
BRUCE, L. J. and G. A. BROUGHTON — Die and Permanent Mold Casting of Nonferrous Metals in the United Kingdom .....	466
BROOKS, M. E. and J. G. HOUSE — Induction Melting in a Magnesium Sand Foundry .....	87
BROUGHTON, G. A. and L. J. BRUCE — Die and Permanent Mold Casting of Nonferrous Metals in the United Kingdom .....	466
BUKOWSKI, A., E. A. LANGE and N. C. HOWELLS — Cast Age-Hardenable Austenitic Steels .....	519
CAINE, J. B. and C. E. MCQUISTON — The Theoretical Concepts of the Packing of Small Particles .....	36
CALVERT, E. D., F. W. WOOD and S. L. AUSMUS — A Casting Technology for Reactive Metals .....	354
CLARK, L. L., W. ROSTOKER and A. H. MURPHY — Improvement of Castings by Press Forging .....	105
COLLIGAN, G. A., L. H. VAN VLACK and R. A. FLINN — The Effect of Temperature and Atmosphere on Iron-Silica Interface Reaction .....	452
DAVIS, H. M. and A. PAL — On the Release of Hydrogen from Molten Aluminum .....	301
DAVIS, M. V. and R. V. SCALCO — Foundry Practice for Sand Casting Commercially Pure Aluminum .....	238
DAWSON, J. V. and L. W. L. SMITH — Gases in Cast Iron with Special Reference to Pickup of Hydrogen in Sand Molds .....	17
DEROSS, A. B. — High Strength Aluminum Alloy X357 Properties and Aging Practice .....	480
DICKERSON, R. F. and A. W. HARE — A Method of Casting Radiator-type Fuel Elements for A Nuclear Reactor .....	210
DIETER, H. W. and T. E. BARLOW — Hot Deformation of Molding Sand .....	7
DONOHO, C. K. and J. F. ELLIS — Magnesium Content and Graphite Forms in Cast Iron .....	203
DOST, F. J. and G. P. RIBAR — Prevention by the Ounce .....	433
DREHER, G. K. — How Patternmakers can Help to Sell Castings .....	583
ECKEL, E. J. — A study of the Ferritization of Nodular Iron .....	151
EDELMAN, R. E., H. W. ANTOS and J. T. NORTON — Foundry Characteristics of a Rammed Graphitic Mold Material for Casting Titanium .....	135
ELLIS, J. F. and C. K. DONOHO — Magnesium Content and Graphite Forms in Cast Iron .....	203
EVANS, E. B. and J. F. WALLACE — Risering of Gray Iron Castings .....	49
FAIRFIELD, H. H. and J. A. ORTIZ — Some Factors Affecting the Toughness of Mild Steel Castings .....	344
FAUSEL, C. E. — Your Foundry and Preventive Maintenance .....	446
FEINBERG, I. J. and J. D. GRIMSLY — Tensile Properties of Microshrinkage-Graded AZ-63 Magnesium Alloy .....	409
FITTERER, G. R. and S. A. PRUSSIN — Some Requirements for Successful Fluidity Testing .....	143
FLEMINGS, D. — The Controlled-Slag Hot-Blast Cupola .....	113
FLEMINGS, M. C., H. F. TAYLOR and C. M. ADAMS, JR. — Solidification and Riser of Gray Iron Castings .....	369
FLEMINGS, M. C., H. F. TAYLOR and E. M. PASSMORE — Fundamental Studies on Effects of Solution Treatment, Iron Content and Chilling of Sand Cast Aluminum-Copper Alloy .....	96
FLEMINGS, M. C., H. F. TAYLOR and S. Z. URAM — Effect of Pressure During Solidification on Microporosity in Aluminum Alloys .....	129
FLEMINGS, M. C., R. W. STRACHAN, E. J. POIRIER and H. F. TAYLOR — Performance of Chills on High Strength Magnesium Alloy Sand Castings of Various Section Thicknesses .....	336
FLEMINGS, M. C., R. W. STRACHAN, E. J. POIRIER and H. F. TAYLOR — Rigging Design of High Strength Magnesium Alloy Castings .....	241
FLINN, R. A. and C. R. MIELKE — Effects of Foundry Variables upon Porosity of 85-5-5-5 Bronze .....	391
FLINN, R. A., G. A. COLLIGAN and L. H. VAN VLACK — The Effect of Temperature and Atmosphere on Iron-Silica Interface Reaction .....	452
GEARY, E. A. — Pattern Standards for Practical Foundry Usage .....	556
GERTSMAN, S. L. and A. E. MURTON — A Literature Review of Metal Penetration .....	1
GLASSENBERG, M., A. H. HESSE and W. H. BAER — Occurrence and Elimination of Leakage in a Gun Metal Casting .....	231
GREEN, H. M., J. ZOTOS and P. J. AHEARN — Ductile High Strength Titanium Castings by Induction Melting .....	225

GREEN, P. W. — Salt Bath Heat Treatment vs. Quench and Temper Standard and Pearlitic Malleable	507	LANGE, E. A. and R. E. MOREY — Sodium Silicates for the CO <sub>2</sub> Process	315
GREEN, R. D. — The Effect of Cooling Rate on the Grain Size of Magnesium Casting Alloys	380	LEMASTER, R. — A Little Knowledge of Plastics	197
GREENLEE, R. H. — Steel Scrap Specifications for Duplexing Cupola White Iron	268	LYSOBEY, W. R. and A. E. TULL — Foundry Applications of the Calcium Carbide Injection Process	327
GRIMSLY, J. D. and I. J. FEINBERG — Tensile Properties of Microshrinkage-Graded AZ-63 Magnesium Alloy	409		
GROTT, G. J. — Particle Packing — Principles and Limitations	553		
HARE, A. W. and R. F. DICKERSON — A Method of Casting Radiator-type Fuel Elements for a Nuclear Reactor	210	McQUISTON, C. E. and J. B. CAINE — The Theoretical Concepts of the Packing of Small Particles	36
HARRIS, R. C. — Deoxidation Practice for Copper Shell-Molded Castings	69	MAREK, C. T. and C. B. WARD — Gas Pressures in Green Sand Mold	361
HEINE, R. W. — Hardenability of Pearlitic Malleable Iron	12	MICHALOWSKI, C., J. PARISI and O. C. NUTTER — Sieve Ratios and Processing for Strong Molding Sands	278
HEINE, R. W. — Observations on Pinhole Defects in White Iron Castings	31	MIELKE, C. R. and R. A. FLINN — Effects of Foundry Variables upon Porosity of 85-5-5 Bronze	391
HEINE, R. W., E. H. KING and J. S. SCHUMACHER — Correlation of Green Strength, Dry Strength and Mold Hardness of Molding Sands	59	MOEHLING, J. P. — Aluminum Melting Practice in the Die Casting and Permanent Mold Fields	533
HEINE, R. W., E. H. KING and J. S. SCHUMACHER — The Problem of Hot Molding Sands	261	MOREY, R. E. and E. A. LANGE — Sodium Silicates for the CO <sub>2</sub> Process	315
HEINE, R. W. and T. W. SEATON — Density of Sand Grain Fractions of the AFS Sieve Analysis	40	MORGENSTERN, D. — Progress in Vacuum Die Casting	199
HESSE, A. H., W. H. BAER and M. GLASSENBERG — Occurrence and Elimination of Leakage in a Gun Metal Casting	231	MURPHY, A. H., L. L. CLARK and W. ROSTCKER — Improvement of Castings by Press Forging	105
HLINKA, J. W. and V. PASCHKIS — Some Remarks on the Relationship of Interface Temperature and Solidification	213	MURTON, A. E. and S. L. GERTSMAN — A Literature Review of Metal Penetration	1
HOFMANN, F. — Investigations on the Effect of Heat on the Bonding Properties of Various Bentonites	305		
HORIGOME, T., I. IGARASHI, C. OHIRA, and K. IKAWA — Formation of Undercooled Graphite in Cast Iron	561	NELSON, B. J. — Effect of Impurities upon the Resistance of Magnesium Casting Alloys AZ92 and AZ63 to Corrosion	544
HOUSE, J. G. and M. E. BROCKS — Induction Melting in a Magnesium Sand Foundry	87	NESTOR, G. — Carbon Dioxide Cores in a Malleable Foundry	252
HOWARD V. J. — Improving Electric Furnace Refractory Life by Special Shell Cooling Techniques	46	NCRMAN, T. E. — Factors Influencing the Resistance of Steel Castings to High Stress Abrasion	187
HOWELLS, N. C., A. BUKOWSKI and E. A. LANGE — Cast Age-Hardenable Austenitic Steels	519	NORTON, J. T., R. E. EDELMAN and H. W. ANTES — Foundry Characteristics of a Rammed Graphitic Mold Material for Casting Titanium	135
HUELSEN, W. — Establishing an Effective Preventive Maintenance Program	439	NUTTER, O. C., C. MICHALOWSKI and J. PARISI — Sieve Ratios and Processing for Strong Molding Sands	278
IGARASHI, I., C. OHIRA, K. IKAWA and T. HORIGOME — Formation of Undercooled Graphite in Cast Iron	561		
IKAWA, K., T. HORIGOME, I. IGARASHI and C. OHIRA — Formation of Undercooled Graphite in Cast Iron	561	OHIRA, G. and K. IKAWA — Formation of Ferrite and Pearlite in Cast Iron	526
IKAWA, K. and C. OHIRA — Formation of Ferrite and Pearlite in Cast Iron	526	OHIRA, G., K. IKAWA, T. HORIGOME and I. IGARASHI — Formation of Undercooled Graphite in Cast Iron	561
JOHNSON, O. E. — The Use of Oil-Bentonite Sand for Higher Quality Finish in Brass and Bronze Castings	415	ORTGIES, R. C. — Dust Piping Modifications to Prevent Material Buildup and Wear	418
KANN, W. L., JR. and N. H. KEYSER — The Effect of Size of Scrap on the Tapping Temperature of a Cupola	397	ORTIZ, J. A. and H. H. FAIRFIELD — Some Factors Affecting the Toughness of Mild Steel Castings	344
KARNOWSKY, M. — An Improved Design for Cast Tensile Bar Molds	284	OTTO, G. — Experiences in Nonferrous Die Casting Die and Permanent Mold Life	184
KEENAN, R. M. — Practical Application of the Work Sampling Technique	578		
KEYSER, N. H. and W. L. KANN, JR. — The Effect of Size of Scrap on the Tapping Temperature of a Cupola	397	PAL, A. and H. M. DAVIS — On the Release of Hydrogen from Molten Aluminum	301
KIDNEY, D. C. — Gating and Risering Shell-Mold Pattern Equipment	312	PARISI, J., O. C. NUTTER and C. MICHALOWSKI — Sieve Ratios and Processing for Strong Molding Sands	278
KING, E. H., J. S. SCHUMACHER and R. W. HEINE — Correlation of Green Strength, Dry Strength and Mold Hardness of Molding Sands	59	PARKER, R. B. — Creating a Climate for Management Development	399
KING, E. H., J. S. SCHUMACHER and R. W. HEINE — The Problem of Hot Molding Sands	261	PARLANTI, C. A. and R. V. VENEKLASEN — The Parlanti Mould Process for the Casting of Metal by Controlled Rate of Heat Transfer	177
LAFORET, H. A. and F. J. WEBBERE — Duplexing Pays at Automotive Foundry	503	PASCHKIS, V. and J. W. HLINKA — Some Remarks on the Relationship of Interface Temperature and Solidification	213
LANGE, E. A., N. C. HOWELLS and A. BUKOWSKI — Cast Age-Hardenable Austenitic Steels	519	PASSMORE, E. M., M. C. FLEMINGS and H. F. TAYLOR — Fundamental Studies on Effects of Solution Treatment, Iron Content and Chilling of Sand Cast Aluminum-Copper Alloy	96
		PEDICINI, L. J. — Packing Characteristics of Typical Foundry Sands	421
		PIERCE, W. B., L. H. VAN VLACK and R. G. WELLS — Reduction of Silica in Large Shell Molds	459
		POIRIER, E. J., H. F. TAYLOR, M. C. FLEMINGS and R. W. STRACHAN — Performance of Chills on High Strength Magnesium Alloy Sand Castings of Various Section Thicknesses	336
		POIRIER, E. J., H. F. TAYLOR, M. C. FLEMINGS and R. W. STRACHAN — Rigging Design of High Strength Magnesium Alloy Castings	241

POWELL, R. C. and H. F. TAYLOR — Shell Molding for Steel Castings .....	403
PRUSSIN, S. A. and G. R. FITTERER — Some Requirements for Successful Fluidity Testing .....	143
PULSIFER, V. — Some Structural Considerations in Nodular Iron .....	56
QUIGLEY, F. C. and B. BOVARNICK — Sintered Alumina Molds for Investment Casting of Steels .....	247
RABE, R. A. — Study of High Temperature Properties of Shell Molds .....	484
REHDER, J. E. and J. E. WILSON — Annealing of Malleable Iron: Effect of Repeated Annealing on Rate of Second Stage Graphitization .....	387
REMMERS, W. E. — Silicon: Present and Future .....	513
RENDA, R. B. and W. M. ZEUNIK — Ladle Heating in the Foundry .....	349
RIBAR, G. P. and F. J. DOST — Prevention by the Ounce .....	433
ROBERTS, D. and E. E. WOODLIFF — Mold Surface Behavior .....	74
ROSTOKER, W., A. H. MURPHY and L. L. CLARK — Improvement of Castings by Press Forging .....	105
RUDDLE, R. W. — The Chemical Treatment of Copper Alloys .....	271
RUTEMILLER, H. C. — New Aluminum-Magnesium-Zinc Casting Alloy .....	222
SCALCO, R. V. and M. V. DAVIS — Foundry Practice for Sand Casting Commercially Pure Aluminum .....	238
SCHALLER, G. S. and W. A. SNYDER — Industrial Applications of Olivine Aggregate .....	295
SCHUMACHER, J. S., R. W. HEINE and E. H. KING — Correlation of Green Strength, Dry Strength and Mold Hardness of Molding Sands .....	59
SCHUMACHER, J. S., R. W. HEINE and E. H. KING — The Problem of Hot Molding Sands .....	261
SCHWABE, W. E. — The Electric Arc in Melting Furnaces .....	571
SEATON, T. W. and R. W. HEINE — Density of Sand Grain Fractions of the AFS Sieve Analysis .....	40
SHELL MOLD and CORE COMMITTEE (8-N) — Shell Molding Survey .....	559
SMITH, L. W. L. and J. V. DAWSON — Gases in Cast Iron with Special Reference to Pickup of Hydrogen in Sand Molds .....	17
SNYDER, W. A. and G. S. SCHALLER — Industrial Applications of Olivine Aggregate .....	295
STRACHAN, R. W., E. J. PORRIER, H. F. TAYLOR and M. C. FLEMINGS — Performance of Chills on High Strength Magnesium Alloy Sand Castings of Various Section Thicknesses .....	336
STRACHAN, R. W., E. J. PORRIER, H. F. TAYLOR and M. C. FLEMINGS — Rigging Design of High Strength Magnesium Alloy Castings .....	241
TAYLOR, H. F., C. M. ADAMS, Jr. and M. C. FLEMINGS — Solidification and Risering of Gray Iron Castings .....	369
TAYLOR, H. F., M. C. FLEMINGS, R. W. STRACHAN and E. J. PORRIER — Performance of Chills on High Strength Magnesium Alloy Sand Castings of Various Section Thicknesses .....	336
TAYLOR, H. F., M. C. FLEMINGS, R. W. STRACHAN and E. J. PORRIER — Rigging Design of High Strength Magnesium Alloy Castings .....	241
TAYLOR, H. F., E. M. PASSMORE and M. C. FLEMINGS — Fundamental Studies on Effects of Solution Treatment, Iron Content and Chilling of Sand Cast Aluminum-Copper Alloy .....	96
TAYLOR, H. F. and R. G. POWELL — Shell Molding for Steel Castings .....	403
TAYLOR, H. F., S. Z. URAM and M. C. FLEMINGS — Effect of Pressure During Solidification on Microporosity in Aluminum Alloys .....	129
TAYLOR, H. F. and D. W. G. WHITE — The Effect of Some Gases on the Work of Adhesion Between a Novolak and Quartz .....	288
TOTE, L. D. and R. S. ZENO — The Effect of Vanadium on the High and Low Temperature Mechanical Properties of a 1Cr-1Mo Cast Steel .....	425
TRUCKENMILLER, W. C., C. R. BAKER and G. H. BASCOM — Evaluation of Shell Molding Process Capability ..	81
TULL, A. E. and W. R. LYSOBEY — Foundry Application of the Calcium Carbide Injection Process .....	327
URAM, S. Z., M. C. FLEMINGS and H. F. TAYLOR — Effect of Pressure during Solidification on Microporosity in Aluminum Alloys .....	129
VAN VLACK, L. H., R. A. FLINN and G. A. COLLIGAN — The Effect of Temperature and Atmosphere on Iron-Silica Interface Reaction .....	452
VAN VLACK, L. H., R. G. WELLS and W. B. PIERCE — Reduction of Silica in Large Shell Molds .....	459
VENEKLASEN, R. D. and C. A. PARLANTI — The Parlanti Mould Process for the Casting of Metal by Controlled Rate of Heat Transfer .....	177
VOGEL, E. G. — Purchase Specifications for Commonly used Steel Foundry Mold and Core Sand Binders .....	125
WALLACE, J. F. and E. B. EVANS — Risering of Gray Iron Castings .....	49
WALSH, E. L. — Noise Induced Hearing Loss .....	324
WARD, C. B. and C. T. MAREK — Gas Pressures in Green Sand Mold .....	361
WEBBERE, F. J. and H. A. LAFORET — Duplexing Pays at Automotive Foundry .....	503
WELLS, R. G., W. B. PIERCE and L. H. VAN VLACK — Reduction of Silica in Large Shell Molds .....	459
WHITE, D. W. G. and H. F. TAYLOR — The Effect of Some Gases on the Work of Adhesion Between a Novolak and Quartz .....	288
WILSON, J. E. and J. E. REHDER — Annealing of Malleable Iron: Effect of Repeated Annealing on Rate of Second Stage Graphitization .....	387
WOOD, F. W., S. L. AUSMUS and E. D. CALVERT — A Casting Technology for Reactive Metals .....	354
WOODLIFF, E. E. and D. ROBERTS — Mold Surface Behavior .....	74
WRIGHT, W. A. — Construction of Shell Mold Patterns and Core Boxes .....	495
WULFF, C. E. — Investigation of the Hardening of Sodium Silicate Bonded Sand .....	91
ZANG, V. E. — Construction Hints and Wear Characteristics of Plastic Patterns and Core Boxes .....	569
ZENO, R. S. and L. D. TOTE — The Effect of Vanadium on the High and Low Temperature Mechanical Properties of a 1Cr-1Mo Cast Steel .....	425
ZEUNIK, W. M. and R. B. RENDA — Ladle Heating in the Foundry .....	349
ZOTOS, J., P. J. AHEARN and H. M. GREEN — Ductile High Strength Titanium Castings by Induction Melting ..	225

## SUBJECT INDEX

### A

- Abrasion**  
High stress, steel castings  
resistance to ..... 187-196
- Additions**  
Aluminum ..... 17, 18, 20, 34  
Ammonium compounds ..... 17  
Argon gas ..... 18, 20  
Bentonites ..... 1, 9, 10, 11  
Bismuth ..... 19, 564, 566  
Carbon ..... 6, 17, 18  
Carbon dioxide gas ..... 18  
Cereal ..... 1, 10  
Coal dust ..... 19, 27  
Copper ..... 544  
Core oil ..... 1  
Deoxidizer ..... 17  
Ferro-cyanides ..... 17  
Ferro-silicons ..... 24  
Fire clay ..... 1, 11  
Fused salt ..... 1  
Iron ..... 547  
Magnesium ..... 24  
Manganese ..... 16, 19, 20, 563  
Nickel ..... 544  
Nitrogen ..... 17  
Oxygen ..... 564  
Pitch ..... 10, 19, 27  
Sea Coal ..... 10  
Selenium ..... 564  
Silica flour ..... 1, 10, 11  
Silicon ..... 16, 544, 563  
Sodium silicates ..... 315-323  
Sulfur ..... 564  
Tellurium ..... 19, 564  
Titanium ..... 16  
Wood flour ..... 10, 11, 27  
Vanadium ..... 425-432
- Adhesion**  
Ammonia effect ..... 291-293  
Between a novolak and quartz,  
gases effect on ..... 288-294  
Nitrogen effect ..... 291-293  
Oxygen effect ..... 291, 292  
Water vapor effect ..... 291-293  
Work of ..... 288
- Age Hardening**  
Austenitic steels ..... 519-525
- Aggregate**  
Olivine, industrial  
applications ..... 295-300
- Aging Practices**  
And properties, aluminum  
alloy X357 ..... 480-483
- Air Quench**  
Hardenability curves ..... 13, 14
- Alloy**  
Aluminum ..... 129-134  
Aluminum-magnesium-zinc,  
new ..... 222-224  
Aluminum, melting practice ..... 497-502

- Alloy (continued)**  
Aluminum, X357, properties and  
aging practices ..... 480-483  
Magnesium, AZ-63, tensile  
properties ..... 409-414  
Magnesium castings,  
rigging design ..... 241-246  
Magnesium, impurities effect on  
corrosion resistance ..... 544-552  
Magnesium, sand castings,  
chill performance ..... 336-343
- Alloys, Copper**  
Chemical treatment ..... 271-277
- Alumina Molds**  
Sintered, investment casting  
steels ..... 247-251
- Aluminum**  
And ferrosilicon, pinholing effect ..... 24  
Briquette-treated melts ..... 302  
Castings, mechanical properties ..... 178  
Chill depth, effect on ..... 18  
Chilling effect, molten ..... 534  
Eliminates pinholes ..... 34  
Experimental melting stock ..... 301-302  
Forms of porosity ..... 301  
Furnaces for melting ..... 534-542  
Gas absorption ..... 534  
Gas vs. electric furnaces ..... 542  
Heat content ..... 539  
Hydrogen effect ..... 534  
Increase in use ..... 533  
Iron absorption ..... 534  
Layer density, cylindrical castings ..... 302  
Magnesium content vs.  
test metal ..... 303  
Magnesium-zinc casting alloy ..... 222-224  
Mean density vs.  
mold temperature ..... 304  
Melting practice, die casting and  
permanent mold ..... 533  
Molten, hydrogen release from  
..... 301-304  
Nitrogen and chlorine fluxing ..... 534  
Pinholing, effect on ..... 20, 22, 23  
Porosity causes ..... 539  
Still bath vs. stirring action ..... 542-543
- Aluminum Alloy**  
Aging graphs ..... 481, 482  
Applied pressure, effect of ..... 133  
Artificial aging ..... 480, 481  
Average aging properties ..... 483  
Average brinell hardness ..... 483  
Casting temperatures used ..... 481  
Degassing techniques ..... 129  
Fluxing ..... 500, 501  
Furnace melting equipment ..... 497-498  
Grain refining ..... 501, 502  
Heat treating and testing ..... 131  
Holding furnace equipment ..... 498  
Hydrogen effect ..... 133  
Hydrogen vs. porosity,  
equations ..... 134
- Aluminum Alloy (continued)**  
Hydrostatic pressure ..... 129, 131  
Ingot analysis ..... 481  
Inherent characteristics of ..... 497  
Inventory control ..... 499  
Mechanical properties vs.  
various pressures ..... 133  
Melting, pouring, solidification  
practice ..... 130, 497-502  
Metal cleanliness ..... 498, 499  
Microporosity vs. mechanical  
properties ..... 129  
Microradiographs ..... 132, 133  
Modification ..... 502  
Nature of solidification ..... 129  
Radiographs ..... 131, 132  
Sludging ..... 499  
Solidification pressure vs.  
microporosity ..... 129-134  
Solution heat treatments ..... 481  
Technique for melting,  
importance ..... 497  
Temperature control ..... 499
- Aluminum Castings**  
Annealing ..... 240  
Application of ..... 238  
Chemical composition ..... 239  
Commercially pure,  
sand casting ..... 238-240  
Factors influencing ..... 238  
Fluxing of melt ..... 239  
Gating and risering ..... 239, 240  
Mechanical and electrical  
properties ..... 178, 240  
Melting and pouring practice ..... 239  
Sand practice ..... 240  
Sawing and grinding ..... 240  
Shakeout ..... 240  
Shrinkage allowance ..... 240
- Aluminum-Copper**  
Chemical analyses,  
experimental heats ..... 97  
Solution treatment, iron content  
and chilling effect ..... 96-103
- Annealability**  
vs. oxygen, malleable iron ..... 18
- Annealing**  
Of malleable iron ..... 387-390  
Rate of ..... 389  
Repeated, effect, second stage  
graphitization ..... 387-390
- Arc, Electric (see also Electric Arc)**  
In melting furnaces ..... 571-577
- Austenitic**  
Gray iron risering ..... 50  
High manganese cast iron,  
hydrogen pickup ..... 19
- Austenitic Steel**  
Age-hardening ..... 519-525  
Alloys used for tests ..... 520-522, 525  
Cr-Mn ..... 522, 525

- Austenitic Steel (continued)  
 Cr-Mn-Ni-V ..... 522-523, 525  
 Cr-Ni-P ..... 520-522, 525  
 Mn-V ..... 523-524, 525  
 Chemical composition of four types ..... 520  
 Machinability ..... 525  
 Nominal analyses-master alloys ..... 519  
 Sand mixtures for ..... 520  
 Solidification characteristics ..... 524-525  
 Solidus temperature vs. composition factor ..... 525  
 Austenitizing  
 Pearlitic malleable, raises hardenability ..... 12

**B**

- Bar Molds  
 Cast, tensile, improved design ..... 284-287  
 Cavity flow, percentage ..... 285, 287  
 Evaluation basis ..... 284, 285  
 Flow uniformity ..... 287  
 Ingates ..... 287  
 Bentonite  
 Additions vs.  
 hot deformation ..... 9, 10, 11  
 Base exchange capacity ..... 305  
 Correct temper moisture content ..... 306  
 Determination of bonding capacity ..... 306  
 Differential thermal analysis ..... 306, 307, 309, 310, 311  
 Dry strength vs. heating temperature ..... 307, 308, 310, 311  
 Green strength vs. heating temperature ..... 307, 308, 309, 310  
 Heat effect on bonding properties ..... 305-311  
 Heat treatment effect on bonding ..... 306  
 Properties with water ..... 307, 308  
 Soda addition ..... 305  
 Temper moisture content vs. heating temperature ..... 308  
 Western-type ..... 305  
 Western vs. southern ..... 307, 308  
 Bibliography  
 Aluminum alloy melting practice ..... 502  
 Aluminum-copper alloy ..... 103  
 Aluminum-magnesium-zinc casting alloy ..... 224  
 Bronze, 85-5-5, porosity, foundry variables effect ..... 396  
 Cast iron, undercooled graphite formation ..... 568  
 Controlled-slag hot-blast cupola ..... 124  
 Copper alloys treatment ..... 227  
 Factors affecting steel castings ..... 348  
 Fluidity testing ..... 149  
 Gases effect on adhesion ..... 294  
 Gases in cast iron ..... 29-30  
 Graphitic molds for titanium ..... 142  
 Gray iron risering ..... 55  
 Heat effect on bentonite ..... 311  
 High strength titanium castings ..... 230  
 High stress abrasion, steel castings ..... 196  
 Hydrogen in molten aluminum ..... 304  
 Iron-Silica interface reaction ..... 458  
 Magnesium alloys, cooling rate effect on grain size ..... 386  
 Metal penetration ..... 6  
 Microporosity in aluminum alloys ..... 134  
 Mol gas pressure ..... 367

- Bibliography (continued)  
 Molding sand sieve ratios ..... 283  
 Nodular iron ferritization ..... 165  
 Reactive metal castings ..... 360  
 Sand grain fraction density ..... 45  
 Shell molded copper castings ..... 73  
 Silica reduction in shell molds ..... 464  
 Sintered alumina molds,  
 investment casting ..... 251  
 Solidification and risering gray iron ..... 379  
 Theories of small particle compaction ..... 39  
 Vanadium effect on a cast steel ..... 423  
 Binders  
 Steel mold and core sand, purchase specifications ..... 125-128  
 Bonded Sand  
 Atmosphere effect ..... 93  
 Carbon dioxide hardening ..... 91, 92  
 Chemical hardening ..... 93  
 Core deterioration ..... 93, 94, 95  
 Gassing time vs. tensile strength ..... 91, 92  
 Hardening methods ..... 91, 95  
 Sodium silicate, hardening ..... 91-95  
 Temperature effect ..... 94  
 Testing materials ..... 91  
 Thermal hardening ..... 92, 93, 94, 95  
 Time effect ..... 93, 94  
 Water evaporation hardening ..... 92  
 Bonding  
 Properties, bentonite, heat effect ..... 305-311  
 Brass  
 And bronze castings, oil-bentonite sand use ..... 415-417  
 Bronze  
 And brass castings, oil-bentonite sand use ..... 415-417  
 Centerline porosity ..... 396  
 Chills, effect of ..... 394-396  
 Complete ..... 394, 395  
 Partial ..... 395, 396  
 85-5-5, foundry variables effect on porosity ..... 391-396  
 Factors governing porosity ..... 391  
 Leak rates ..... 392, 393  
 Melting and pouring practice ..... 391  
 Moisture content of sand ..... 393, 394  
 Molding practice ..... 391  
 Pouring temperature ..... 392  
 Pressure testing ..... 391, 392  
 Temperature data, leakage ..... 392  
 Dry sand ..... 392  
 Geometrical distribution ..... 392  
 Green sand ..... 392

**C**

- Calcium Carbide Injection  
 Brinnell hardness vs. section size ..... 334  
 Case histories ..... 329-332  
 Chill vs. microstructures ..... 333, 334  
 Equipment for ..... 327, 328  
 Induction melting ..... 335  
 Physical properties ..... 333, 335  
 Principles of ..... 327  
 Process, applications of ..... 327-335  
 Carbon  
 Content vs. metal penetration ..... 1  
 Losses in cast iron ..... 18  
 Carbon Dioxide  
 Amount required to attain viscosity ..... 320  
 And air mixtures ..... 323  
 Concentration and flow rate vs. gassing time ..... 323

- Carbon Dioxide (continued)  
 Decreases hydrogen content ..... 18  
 Gassed strength ..... 318  
 Process, chemistry of ..... 315-317  
 Process, sodium silicates for ..... 315-323  
 Carbon Dioxide Cores  
 Casting surface ..... 253  
 Chemical analysis, molasses used ..... 252  
 Comparison, carbon dioxide and core oil sand ..... 253  
 Core collapsibility ..... 256  
 Gassed properties ..... 252, 253  
 Gassing time vs. core storage life ..... 254  
 Green compressive strength ..... 252  
 In a malleable foundry ..... 252-256  
 Sand sieve analysis ..... 253  
 Sand temperature core weight relationship ..... 254  
 Sand temperature vs. core storage life ..... 254  
 Sand temperature vs. tensile strengths ..... 254  
 Sodium silicate sand mix ..... 253, 256  
 Temperature-hardness relationship ..... 255

**Casting**

- Aluminum, foundry practice ..... 238-240  
 Die and permanent mold, nonferrous ..... 184-186  
 Gun-metal, occurrence and elimination of leakage ..... 231-237  
 Investment, sintered alumina molds ..... 247-251  
 Metal, by controlled heat transfer ..... 177-183  
 Nuclear reactor fuel elements, radiator type ..... 210-212  
 Reactive metals ..... 257-260  
 Technology, reactive metals ..... 354-360

**Castings**

- Improvement by press forging ..... 105-112  
 Magnesium alloy, chill performance ..... 336-343  
 Magnesium, rigging design ..... 241-246  
 Shell-molded, copper ..... 69-73  
 Steel, factors affecting toughness ..... 344-348  
 Steel, resistance to high stress abrasion ..... 187-196  
 Titanium, high strength ..... 225-230  
 Titanium, rammed graphitic mold materials ..... 135-142

**Cast Iron**

- Areal ratios, ferrite to pearlite, manganese added ..... 527  
 Base compositions and mechanical properties, test irons ..... 203, 204  
 Carbon content and graphite structure ..... 561-563  
 Eutectiform graphite and spherulite ..... 207, 209  
 Graphite, decomposed, in end-chilled pig iron ..... 565-566  
 Ferrite and pearlite formation ..... 526-532  
 Ferrite and pearlite formation in spheroidal graphite ..... 530-531  
 Ferrite of alloys melted, manganese added ..... 527  
 Ferrite vs. tin content ..... 531  
 Formation mechanism, ferrite and pearlite ..... 526  
 Gases in, effect ..... 17-30  
 Graphite classification ..... 207

**Cast Iron (continued)**  
 Graphite structure, additions  
   effect ..... 563-565, 566  
 Hydrogen effect ..... 17, 18, 19  
 Hydrogen pickup, sand mold ..... 19-28  
 Hypereutectic iron ..... 209  
 Hypoeutectic iron ..... 209  
 Ledeburite decomposition on  
   heating ..... 567, 568  
 Magnesium content and graphite  
   forms in ..... 203-209  
 Magnesium content vs.  
   elongation ..... 205  
 Magnesium content vs.  
   tensile strength ..... 203  
 Magnesium content vs.  
   yield strength ..... 203  
 Magnesium effect on graphite  
   structure ..... 205  
 Manganese effect on  
   structure ..... 526-527  
 Nitrogen effect ..... 17  
 Oxygen effect ..... 17  
 Pearlitic malleable  
   hardenability ..... 12-16  
 Pearlite matrix formation ..... 528  
 Pearlite matrix with acicular  
   cementite formation ..... 527-528  
 Phosphorus and tin effect  
   on matrix ..... 530  
 Pinholing ..... 19-29  
   Aluminum effect ..... 20, 23, 24, 25  
   Appearance of ..... 19  
   Ferrosilicon effect ..... 24, 25  
   Hydrogen content effect ..... 26  
   Magnesium effect ..... 24, 26  
   Manganese effect ..... 20, 22  
   Minimized ..... 19  
   Other elements effect ..... 26  
   Prevention of ..... 19  
   Pouring temperature effect ..... 28  
   Titanium effect ..... 21, 23, 26, 27  
 Shell molded ..... 459  
 Structure of ..... 526  
 Undercooled graphite  
   formation ..... 18, 561-568

**Cast Steel**  
 Chemical composition, test blocks ..... 425  
 Energy and fracture appearance  
   graphs ..... 429  
 Heat treatments used, and hardness  
   results ..... 426  
 Low alloy ..... 425  
 Mechanical properties, vanadium  
   effect ..... 425-432  
 Parameter creep data ..... 432  
 Parameter rupture data ..... 430, 431  
 Room temperature tensile results ..... 428  
 V-notch charpy impact ..... 429, 430  
 X-ray results ..... 428

**Cereal**  
 Additions vs. hot deformation ..... 10

**Charpy**  
 Impact tests ..... 153, 162, 163, 429

**Chemical Composition**  
 Cast steel test blocks ..... 425  
 Hardenability, pearlitic malleable ..... 12

**Chemical Treatment**  
 Charcoal in melt, effect ..... 271  
 Copper alloys ..... 271-277  
 Flux vs. soundness and tensile  
   properties ..... 275  
 Gas content assessment ..... 277  
 Gas removal, hydrogen ..... 273  
 Grain refinement ..... 277  
 Hydrogen, oxygen equilibrium  
   in molten copper ..... 274  
 Melting fluxes ..... 271, 272

**Chemical Treatment (continued)**  
 Melting treatments vs. metal loss ..... 272  
 Prevention of compound gas  
   unsoundness ..... 273  
 Oxidation-reduction  
   treatment ..... 274, 275, 276  
 Residual phosphorous vs.  
   porosity ..... 275  
 Solubility of hydrogen in  
   copper alloys ..... 273

**Chilling**  
 Aluminum-copper alloy, effect ..... 96-103

**Committee and Research Reports**  
 Basic Concepts Committee  
   (8-V) ..... 40, 553  
 Brass and Bronze Research Committee (3-C) ..... 391  
 Controlled Annealing Committee  
   (6-D) ..... 186  
 Gray Iron Division Research ..... 49  
 Pearlitic Malleable Committee  
   (6-E) ..... 12  
 Shell Mold and Core Committee  
   (8-N) ..... 599  
 Shell Molding Committee (8-N) ..... 484

**Compaction**  
 Blending natural deposits ..... 554  
 Configurations ..... 37  
   Cubic packing ..... 37  
   Orthorhombic packing ..... 37  
 Crushed material, use of ..... 553-554  
 Density vs. GFN ..... 422  
 Distribution changes, density ..... 38  
 Green compressive strength vs.  
   density at different ramming  
   levels ..... 422  
 Green properties, bonded ..... 423, 424  
 Largest particle size effect on  
   density ..... 38  
 Nonuniform particles ..... 37  
 Of small particles, theories ..... 36-39  
 Ottawa Sand ..... 554  
 Permeability vs. GFN ..... 423  
 Principles and limitations ..... 553-555  
 Properties at 10 psi green com-  
   pressive strength ..... 424  
 Radius ratios ..... 39  
 Rammed density, bonded ..... 422, 423  
 Rammed density, dry ..... 421, 422  
 Sieve analysis of tested  
   sands ..... 422, 555  
 Spherical particles ..... 36  
 Theoretical densities ..... 37, 38  
 Uniform particles ..... 36, 37

**Cooling Rate**  
 Effect on grain-size, magnesium  
   alloys ..... 380-386  
 Vs. ferrite formation, nodular  
   iron ..... 154, 155

**Copper**  
 Alloys, chemical treatment ..... 271-277  
 Shell-molded castings ..... 69-73

**Core Boxes**  
 And patterns, shell mold, con-  
   struction ..... 495-496  
 Wear and construction, plastic  
   patterns and ..... 569-570

**Cores**  
 Carbon dioxide, malleable  
   foundry ..... 252-256  
 Metal penetration in sand ..... 1

**Corrosion**  
 Resistance, magnesium alloy,  
   impurities effect ..... 544-552

**Cupola**  
 Blast temperature ..... 14  
 Blast velocity vs. metal tempera-  
   ture ..... 118, 119

**Cupola (continued)**  
 Cleaning system ..... 114  
 Coke charge used, scrap ..... 397  
 Conical design ..... 118, 119  
 Controlled-slag hot-blast ..... 113-124  
 Heat loss ..... 119  
 Heat sources vs. heat dissipation ..... 123  
 Hot-blast system ..... 114  
 Inferior fuels ..... 122  
 Melting rate vs. heat loss ..... 121  
 Metal analysis change ..... 117  
 Metal charges used, scrap ..... 397  
 Operation, scrap effect ..... 397  
 Recuperative system ..... 114  
 Recuperator installation ..... 114, 115  
   Automatic control equipment ..... 115  
   Blast temperature amplifier ..... 115  
   Pressure element ..... 115  
 Refractory lining contour ..... 117, 118  
 Size limitation ..... 121, 122  
 Slag ..... 117, 119, 120, 123  
   Chemistry and silicon content  
   vs. metal temperature ..... 123  
 Tapping temperature, scrap  
   size effect ..... 397-398  
 Temperature control ..... 117  
 The cupola proper ..... 115, 116, 117  
   Internal conditions ..... 116  
   Silica ..... 116  
 tuyere cooling vs. heat loss ..... 121  
 White iron duplexing, steel scrap  
   specifications ..... 268-270

**D**

**Decarburization**  
 Lowers metal penetration ..... 6

**Density**  
 Of sand grain fractions, sieve  
   analysis ..... 40-45

**Deoxidation**  
 Copper shell-molded castings ..... 69-73

**Design**  
 Improved, cast tensile bar  
   molds ..... 284-287  
 Rigging, magnesium alloy  
   castings ..... 241-246

**Die Casting**  
 Aluminum ..... 185  
 And permanent mold, aluminum  
   melting practice ..... 533-543  
 Cold chamber process ..... 201  
 Die welding repair ..... 185  
 Draft vs. soldering ..... 185  
 Entrapped air problem ..... 199  
 Hot chamber process ..... 199  
 Mold coating and lubricants,  
   effect ..... 185  
 Temperature vs. die life ..... 186  
 Vacuum, benefits ..... 200  
 Vacuum, progress in ..... 199-202  
 Water spraying, effect ..... 185

**Duplexing**  
 Advantages ..... 503, 504  
 Benefits ..... 503-504, 506  
 Chill control with ..... 505  
 Composition control with ..... 505  
 Cupola white iron, steel scrap  
   specifications ..... 268-270  
 Disadvantages of ..... 506  
 In automotive foundry ..... 503-506  
 Increased productivity ..... 506  
 Plant arrangement for ..... 504  
 Scrap reduction with ..... 505  
 Temperature control with ..... 505

**Dust Piping**  
 Modifications, to prevent material  
   buildup and wear ..... 418-420  
 Ventilation ..... 418-420

- Dust Piping (continued)**
- Aerator ..... 419
  - Elbow ..... 418
  - Elevator ..... 420
  - Rotary screen ..... 420
  - Sand bin ..... 420
  - Sand mixer ..... 419
- E**
- Electric Arc**
- Characteristics of ..... 575
  - Classification of ..... 571
  - Dynamic characteristics ..... 576
  - Electrodes for ..... 576-577
  - Energy distribution of ..... 573
  - External forces effect ..... 574-575
  - Ignition of ..... 572
  - In melting furnaces ..... 571-577
  - Mechanical forces in ..... 573
  - Melt-surface depression ..... 574
  - Pinch effect ..... 573-574
  - Potential distribution ..... 572-573
  - Split ..... 572
  - Static characteristics ..... 575
  - Utilization of power in ..... 576
- Electric Furnace**
- Arc ..... 571-577
  - Electrode coolers ..... 46, 47
  - Equipment used ..... 46
  - Gland ..... 46, 47
  - Refractory shell cooling techniques ..... 46-48
  - Refractory thickness ..... 47
  - Ring coolers ..... 46, 47
  - Shell cooler ..... 47, 48
- End Quench**
- Hardenability curves ..... 12, 13, 14, 15, 16
- F**
- Ferrite**
- And pearlite formation, cast iron ..... 526-532
  - Formation vs. cooling rates, nodular iron ..... 154, 155
- Fire Clay**
- Additions vs. hot deformation ..... 10, 11
  - Bonded sands ..... 7
- Fluidity Testing**
- Calculation, dimensions, plant reservoir fluidimeter ..... 149, 150
  - Fluidimeter ..... 143
  - Fluidimeter mold ..... 144, 145, 146
  - Flow cessation mechanism ..... 147
  - Mechanism control ..... 148
  - Method of measuring ..... 143
  - Slag and metal flow ..... 144
  - Some requirements for ..... 143-150
  - Steel flow, curves ..... 144
  - Temperature vs. fluidity in zinc ..... 147, 148
  - Variables ..... 143
- Foundry**
- Application, calcium carbide injection process ..... 327-335
  - Automotive, duplexing ..... 503-506
  - Induction melting, magnesium ..... 87-90
  - Ladle heating ..... 349-353
  - Malleable, carbon dioxide cores in ..... 252-256
  - Pattern standards ..... 556-558
  - Practice, sand casting aluminum ..... 238-240
  - Purchase specifications, steel mold and core sand binders ..... 125-128
- Foundry (continued)**
- Sand, packing characteristics ..... 421-424
  - Variables effect on porosity, 85-5-5 bronze ..... 391-396
- G**
- Gases**
- Adhesion between a novolak and quartz effect ..... 288-294
  - Equations for calculating effect ..... 289
  - In cast iron ..... 17-30
  - Pinholing effect ..... 33, 34, 35
  - Strength of bond effect ..... 288, 289
- Gas Pressures**
- Batch properties ..... 364
  - Blow-hole size ..... 364
  - Changing zones in molds ..... 361, 362
  - Compaction energy, equations ..... 367, 368
  - Depth of sand vs. time ..... 366
  - Experimental pressure data ..... 368
  - Growth of zones, equations ..... 366
  - In green sand mold ..... 361-368
  - Moisture effect on mold gas pressure ..... 365
  - Moisture effect on permeability ..... 365
  - Mold-metal interface ..... 361
  - Mold pressure ..... 361, 366
  - Permeability ..... 362, 363
  - Permeability effect, mold ..... 365
  - Permeability, equations ..... 367
  - Pressure measurement ..... 362, 363, 364
  - Pressure vs. time ..... 364
  - Sand conductivity, equations ..... 367
  - Temperature measurement ..... 363, 364
  - Time-temperature-distance from interface, relationship ..... 365
  - Units of designation ..... 368
- Gating**
- And risering shell-mold pattern equipment ..... 312-314
  - To prevent pinholing ..... 33, 34, 35
- Graphite**
- Forms and magnesium content, cast iron ..... 203-209
  - Undercooled, formation, cast iron ..... 561-568
- Graphite Films**
- Formation ..... 19
  - White Iron ..... 19
- Graphitization**
- First stage ..... 387
  - Second stage, repeated annealing effect ..... 387-390
- Gray Iron (see also Malleable Iron, Nodular Iron, Pearlitic Malleable)**
- Atmospheric pressure effect ..... 377, 378
  - Austenite dendrites ..... 50
  - Behavior of riser variations ..... 376-379
  - Constants values, solidification calculations ..... 373
  - Dimensional and volume changes ..... 376
  - Exothermic risers ..... 378, 375
  - Equations, solidification and risering ..... 374, 375
  - Eutectic cells ..... 50
  - Factors governing shrinkage ..... 371
  - Ferstatic pressures ..... 372
  - Freezing temperature range ..... 50
  - Good riser recommendations ..... 54
  - Graphite flakes ..... 50
  - Graphite precipitation ..... 371
  - Heat evolved in cooling ..... 375
  - Hypoeutectic ..... 50
  - Importance of dilation ..... 372
  - Inoculation of ..... 50
- Gray Iron (continued)**
- Iron-carbon-silicon system ..... 373-374
  - Location of risers ..... 53
  - Microporosity problems ..... 50, 51
  - Molding and Risering conditions effect ..... 371, 372
  - Mold materials effect on risering ..... 50, 51, 52
  - Casting movement, solidification ..... 51
  - Green and dry sand ..... 50
  - Mold wall movement ..... 50, 52
  - Shrinkage distribution ..... 371, 372, 373
  - Volume changes, solidification ..... 373, 374
  - Pearlitic malleable, hardenability ..... 12-16
  - Phosphorus effect ..... 50
  - Rate of solidification ..... 374, 375
  - Research conclusions ..... 369, 370, 371
  - Risering ..... 49-55, 369-379
  - Riser neck selection ..... 53-55
  - Dimensions ..... 55
  - Recommendations ..... 53, 54
  - Riser size selection ..... 51-53
  - Dimensions ..... 52
  - Equations for calculating ..... 52
  - Liquid contraction ..... 52
  - Variables ..... 51, 52
  - Shrink behavior of a typical ..... 375, 376
  - Solidification and risering ..... 369-379
  - Solidification mechanism ..... 49, 50, 51
  - Temperature vs. cooling time ..... 376
  - Green Sand
  - Mold, gas pressures in ..... 361-368
  - Gun-Metal Casting**
  - Blind risers ..... 234, 235
  - Chills ..... 236, 237
  - Dimensions, sprue, runner, gates ..... 234
  - Melting ..... 232
  - Molding and core sand mixtures ..... 233
  - Occurrence and elimination of leakage ..... 231-237
  - Pressure testing ..... 233
  - Sand properties ..... 235
  - Tensile properties ..... 235
- H**
- Hardenability**
- Austenitizing raises ..... 12
  - Chemical composition, test bars ..... 12
  - Graphs ..... 12, 13, 14, 15, 16
  - Iron with manganese and silicon ..... 16
  - Normal range, pearlitic malleable ..... 16
  - Pearlitic malleable ..... 12-16
  - Testing, pearlitic malleable ..... 12
- Hardening**
- Sodium silicate bonded sand ..... 91-95
- Hearing**
- Audiometric examination ..... 326
  - Loss, noise induced ..... 324-326
- Heat Transfer**
- Controlled, process for casting ..... 177-183
  - Limits metal penetration ..... 2
- Heat Treatment**
- Vs. quench and temper, standard and pearlitic malleable ..... 507-512
- Hot-Blast Cupola**
- Controlled-slag, the ..... 113-124
- Hot Deformation**
- Additions vs. ..... 9
  - Bentonite blends vs. ..... 10
  - Hot Compressive strength vs. ..... 8, 9
  - Moisture vs. ..... 9
  - Temperature vs. ..... 8, 9

Hot Deformation (continued)  
 Ultimate hot deformation vs. .... 8  
 Cushioning material to increase ... 7  
 Equations for calculating ..... 7  
 Equipment for measuring ..... 8  
 Expression of ..... 7  
 Molding sands ..... 7-11  
 Rate of ..... 7  
 Hot Toughness  
 Additions effect ..... 10, 11  
 At elevated temperatures ..... 10, 11  
 Meaning of ..... 8  
 Peaks ..... 10, 11  
 Sand ..... 7  
 Varies with bonds, additions,  
     temperature ..... 10  
 Hoyt, Charles Edgar  
     Memorial Lecture, Silicon:  
         Present and Future ..... 513  
 Hydrogen  
     Content raised, damp sand ..... 19  
     Factors affecting ..... 29  
     Flake-graphite iron, effect on ..... 18  
     Pickup from sand molds ..... 19-28  
     Pinholing effect ..... 34  
     Release from molten  
         aluminum ..... 301-304  
     Solubility ..... 29  
     Titanium effect ..... 18

**I**

Impurities  
 Magnesium alloys resistance to  
     corrosion, effect of ..... 544-552  
 Induction Melting  
 Ductile high strength titanium  
     castings ..... 225-230  
 Flux consumption ..... 89  
 In magnesium sand foundry ..... 87-90  
 Labor needed ..... 89  
 Meltdown metal loss ..... 89  
 Injection  
 Process, calcium carbide ..... 327-335  
 Inoculation, Gray iron ..... 50  
 Investment Casting  
 Economic advantages ..... 250, 251  
 Melt out and firing cycle ..... 249, 250  
 Metal casting ..... 250, 251  
 Mold properties ..... 247  
 Slip and mold preparation ..... 248, 249  
 Steels, sintered alumina  
     molds ..... 247-251  
 Wax patterns ..... 247  
 Iron, Cast  
 Ferrite and pearlite  
     formation ..... 526-532  
 Gases in ..... 17-30  
 Magnesium content and graphite  
     forms in ..... 203-209  
 Undercooled graphite formation  
     in ..... 561-568  
 Iron Content  
 Aluminum copper alloy  
     effect ..... 96-103  
 Iron, Gray  
 Risering ..... 49-55  
 Iron, Malleable  
 Annealing of ..... 387-390  
 Microstructures, effect and  
     cause ..... 166-176  
 Iron, Nodular  
 Ferritization ..... 151-165  
 Structural considerations ..... 56-58  
 Iron-Silica  
 Interface reaction, atmosphere and  
     temperature effect ..... 452-458

Iron, White  
 Duplexing, cupola, steel scrap  
     specifications ..... 268-270

**L**

Ladle Heating  
 Aspirator-type burner ..... 352, 353  
 In the foundry ..... 349-353  
 Premixing burner ..... 349, 350, 351, 352  
 Temperature-time  
     curves ..... 350, 351, 352  
 Leakage  
 In gun-metal casting, occurrence  
     and elimination ..... 231-237  
 Liquid Quench  
 Pearlitic malleable, graphs ..... 13, 14

**M**

Machinability  
 Pearlitic malleable ..... 12  
 Magnesium  
 Content, and graphite forms,  
     cast iron ..... 203-209  
 Pinholing effect ..... 21, 23, 26, 27  
 Vs. sulfur, nodular iron ..... 58  
     -Aluminum-zinc casting alloy ..... 222-224  
 Magnesium Alloy  
 Acid dip test, AZ92  
 Aluminum content, test specimen ..... 410  
 Chemical composition control ..... 410  
 Chrome-pickle treatment ..... 544  
 Composition limits, AZ92 and  
     AZ63 ..... 544  
 Composition, properties and corro-  
     sion losses ..... 546-548  
 Copper effect on AZ92 and  
     AZ63 ..... 544, 547, 552  
 Corrosion tests made, AZ92 and  
     AZ63 ..... 545  
 Determination of tensile  
     properties ..... 411-413  
     Equations for ..... 411-413  
     Mean, and scatter ..... 411  
     Regression coefficient ..... 411, 412  
     Standard deviations ..... 411  
 Elongation minima ..... 413  
 Gradations in microshrinkage ..... 410  
 Impurities effect on corrosion  
     resistance, AZ92 and AZ63 ..... 544-552  
 Industrial atmosphere tests,  
     AZ92 and AZ63 ..... 551  
 Iron effect, AZ92 and AZ63 ..... 547  
 Mean elongation ..... 412  
 Mean ultimate tensile strength ..... 412  
 Mean yield strength ..... 412  
 Nature of microshrinkage ..... 409, 410  
 Nickel effect, AZ92 and  
     AZ63 ..... 544-545, 547, 551-552  
 Radiographic classification ..... 411  
 Radiographs for quality  
     control ..... 409, 410  
 Salt peroxide spray tests, AZ92  
     and AZ63 ..... 545  
 Salt spray tests, AZ92 and  
     AZ63 ..... 545, 547  
 Silicon effect, AZ92 and AZ63 ..... 544  
 Temps used for tests, AZ92  
     and AZ63 ..... 544  
 Tensile tests, AZ92 and AZ63 ..... 544  
 Types of microshrinkage ..... 409  
 Ultimate strength minima ..... 413  
 Yield strength minima ..... 413

Magnesium Castings  
 Achieving fine grain size ..... 380  
 Alloy composition, for tests ..... 380, 381  
 Chemical analysis ..... 338  
 Chemical analysis,  
     experimental heats ..... 242, 342

Magnesium Castings (continued)  
 Chemical control and melting  
     practice ..... 241, 242, 337  
 Chills used ..... 243  
 Chilling vs. mechanical  
     properties ..... 341  
 Chilling vs. tensile strength ..... 241  
 Cleaning and heat treatment ..... 244  
 Cooling range ..... 382, 383  
 Cooling rate vs. grain size ..... 383-385  
 End chills ..... 338  
 Foundry data large and small  
     gimbal castings ..... 242, 243  
 Gating, risering, molding ..... 337  
 Grain refinement ..... 337  
 Grain sizes ..... 339-340  
 Heat treatment ..... 337  
 High strength sand castings,  
     chill performance ..... 336-343  
 Markets for ..... 336  
 Mechanical properties ..... 245, 246  
     Chilled ..... 337, 338, 339, 342  
     Specifications ..... 340, 341  
 Metallographic examination ..... 337, 338  
 Microstructure rating ..... 338  
 Molding procedure, gimbal  
     castings ..... 242, 243, 244  
 Rigging design ..... 241-246, 341  
 Solidification progress  
     micrographs ..... 381-384  
 Spectroanalysis, test  
     composition ..... 380, 381  
 Tensile properties ..... 338  
 Maintenance  
 A matter of logic ..... 439  
 And mechanization ..... 446  
 Compressed air ..... 438  
 Cranes and hoists ..... 437, 438  
 Definition of ..... 446  
 Engineering for preventive ..... 444  
 Engineering standards and inspec-  
     tion follow-up ..... 444, 445  
 Fuel burning appliances ..... 438  
 In management ..... 445  
 Inspection frequency ..... 441  
 Material handling ..... 436-437  
     Belt and gravity conveyors ..... 437  
     Bucket elevator boot and clam-  
         shell buckets ..... 437  
     Molding machines ..... 437  
     Self-propelled vehicles ..... 436  
     Towed or pushed vehicles ..... 436, 437  
 Melting equipment ..... 438  
 Per cent maintenance workers  
     in plants ..... 446  
 Plan for preventive ..... 441  
 Plant department duties ..... 433  
 Power supply ..... 433-434  
 Prevention by the ounce ..... 433-438  
 Preventive, in foundry ..... 446-451  
 Program, establishing an  
     effective ..... 439-445  
 Programs ..... 447-449, 451  
     Air cylinder ..... 448  
     Departmental ..... 451  
     Inspection ..... 451  
     Lubrication ..... 447  
     Truck ..... 448, 449  
 Records ..... 443  
 Utilities importance ..... 439-441  
 Utilization apparatus inspection  
     and ..... 434, 435, 436  
 Electric motors ..... 434  
 Generator and rectifiers ..... 435  
 Heating ..... 436  
 Lifting magnets and magnetic  
     pulleys ..... 435, 436  
 Lighting ..... 436

- Maintenance (continued)  
 Magnetic brakes ..... 435  
 Motor controllers ..... 434, 435  
 Signals ..... 436  
 Visual record board ..... 443, 444
- Malleable Iron  
 Annealing rate ..... 389  
 Basic chemistry, standard and  
     pearlitic ..... 507  
 Black heart ..... 387  
 Charge, typical, standard and  
     pearlitic ..... 507  
 First stage graphitization ..... 387  
 Foundry, carbon dioxide cores  
     in ..... 252-256  
 Hardness determinations ..... 389, 390  
 Hardness values, standard and  
     pearlitic ..... 510  
 Holding time effect ..... 389  
 Mechanical properties, typical,  
     standard and pearlitic  
        ..... 507, 508, 510  
 Microstructures ..... 167-175  
 Microstructures, effect and  
     cause ..... 166-176  
 Number of anneals vs. hardness  
     and annealing rate ..... 388  
 Number of traverses vs. maximum  
     cooling rate ..... 389  
 Oxygen vs. annealability ..... 18  
 Pearlite, hardenability ..... 12-16  
 Pinholing ..... 31  
 Repeated annealing effect, second  
     stage graphitization ..... 387-390  
 Salt bath heat treatment ..... 510, 512  
 Slow-cool process ..... 387  
 Standard and pearlitic, heat  
     treatment vs. quench and  
     temper ..... 507-508, 510  
 Surface effects ..... 388, 390  
 Ways of eliminating pearlite,  
     second stage graphitization ..... 387  
 White iron composition, test metal,  
     annealing ..... 388
- Management  
 Broadening the experience of potential ..... 400  
 Development, creating a climate for ..... 399-402  
 Intangible qualities of good ..... 399  
 Job switching ..... 401, 402  
 Putting ideas into practice of potential ..... 400  
 Selection of candidates for ..... 399  
 Training program, a ..... 399
- Manganese  
 As pinholing cause ..... 19  
 Pinholing, effect on ..... 20, 22  
 In pearlitic malleable, hardenability ..... 16
- Melting, Induction  
 Ductile, high strength titanium castings ..... 225-230  
 Magnesium sand foundry ..... 87-90
- Melting Practice  
 Aluminum casting alloys ..... 497-502  
 Aluminum, die casting and permanent mold ..... 533-543
- Metal Casting  
 By controlled heat transfer ..... 177-183  
 Casting design ..... 183  
 Cooling rate, metal mold  
     materials ..... 178  
 Copper alloys ..... 182  
 Cores ..... 180  
 Feed metal vs. physical properties, aluminum, effect ..... 179

- Metal Casting (continued)  
 High thermal conductivity,  
     aluminum ..... 178  
 Light metals ..... 181  
 Mechanical properties, aluminum  
     castings ..... 178  
 Permanent mold ..... 177  
 Process, effect of ..... 179  
 Risers effect ..... 177  
 Sand ..... 177  
 Steel ..... 182  
 Vacuum techniques ..... 182
- Metal Penetration  
 Alleviated by washes ..... 4  
 As a gas ..... 1  
 As an oxide ..... 1  
 Depth vs. pressure ..... 5  
 Elimination by core mixes ..... 6  
 In cores and molds ..... 1  
 Increases with metal head ..... 3  
 Increases with temperature ..... 3  
 Literature review ..... 1-6  
 Major causes ..... 1  
 Metal head effect ..... 4  
 Resistance ..... 4  
     Decreased with excessive  
     ramming ..... 4  
     Increased with ramming ..... 4  
 Test castings used for metal ..... 1, 2, 3
- Metals  
 Nonferrous, die and permanent  
     mold casting ..... 466-479  
 Reactive, casting ..... 257-260  
 Reactive, casting technology ..... 354-360
- Microporosity  
 Problem, gray iron castings ..... 50, 51  
 Vs. solidification pressure,  
     aluminum alloys ..... 129-134
- Microshrinkage  
 -Graded AZ-63 magnesium alloy,  
     tensile properties ..... 409-414
- Microstructures  
 Malleable iron, effect and  
     cause ..... 166-176
- Moisture  
 Control to prevent pinholing ..... 33  
 Sand, hot deformation rate ..... 9  
 Vs. hydrogen content ..... 18
- Mold  
 Controls necessary ..... 76  
 Expansion graphs ..... 76-80  
 Metal penetration in sand ..... 1  
 Penetration for steel ..... 4  
 Rammed graphite material,  
     titanium castings ..... 135-142  
 Rammed, movement ..... 74  
 Ramming vs. penetrating pressure ..... 3  
 Rate of expansion, data ..... 77  
 Steel and core sand binders,  
     purchase specifications ..... 125-128  
 Surface behavior ..... 74-80  
 Temperature ranges ..... 76  
 Thermal growth ..... 74
- Mold Hardness  
 Molding sands ..... 59-68
- Mold Materials  
 Risering, gray iron, effect ..... 50, 51
- Mold Process  
 Metal casting, by controlled heat transfer ..... 177-183
- Molding Sand (see also Sand)  
 Additions vs. hot  
     deformation ..... 9, 10, 11  
 Additives effect, metal penetration ..... 1  
 At elevated temperatures ..... 7  
 Bentonites vs. hot  
     deformation ..... 9, 10, 11  
 Clay effect ..... 61, 62
- Molding Sand (continued)  
 Clay type equivalence ..... 64  
 Compressive hot strength ..... 7  
 Compressive load, rammed  
     specimen ..... 7  
 Cooling hot sands ..... 263  
 Correlation, method of ..... 59, 60, 61  
 Cubical volume relationship ..... 280  
 Cubic packing ..... 279, 280  
 Cushioning material ..... 7  
 Developing properties in ..... 265  
 Dry compressive  
     strength ..... 265, 266, 267  
 Dry strength and green strength  
     combinations ..... 68  
 Dry strength vs. per cent of water ..... 66  
 External load ..... 7  
 Fire clay ..... 63  
 Fool-proof sand ..... 280, 281  
 Green compressive  
     strength ..... 265, 266, 267  
 Green strength, dry strength, mold  
     hardness, correlation ..... 59-68  
 Green strength vs. dry strength ..... 60-68  
 Hot deformation ..... 7-11  
 Hot toughness ..... 7, 8, 10, 11  
 Internal loading ..... 7  
 Inter-sand-grain movement ..... 7  
 Mixes ..... 7  
 Mixing and uniformity ..... 282  
 Moisture in sands ..... 263, 264  
 Moisture vs. hot deformation ..... 9  
 Mold hardness vs. green and dry  
     strength ..... 60  
 Mold hardness vs. green  
     strength ..... 61, 63-67  
 Mulling ..... 283  
     Effect ..... 262, 263  
     Time change, effect ..... 265-267  
 Time vs. green and dry  
     strength ..... 265  
 Time vs. temperature and  
     moisture ..... 262, 263  
 Time vs. temperature, moisture,  
     green and dry strength ..... 262  
     To prevent pinholing ..... 33  
 Preparation ..... 283  
 Problem of hot ..... 261-267  
 Relative mesh-cube volumes ..... 280  
 Restraining loads ..... 7  
 Rhombohedral and Rhombic  
     packing ..... 278, 279  
 Sand temperature vs. cooling  
     during mulling ..... 265  
 Screen-size distribution ..... 278  
 Sieve ratios and processing for  
     strong ..... 278-283  
 Silica sand expansion forces ..... 7  
 Southern bentonite ..... 63  
 Southern bentonite properties ..... 261  
 Steel casting sands ..... 7  
 Support balls estimation ..... 281  
 Thermal-static pressure ..... 7  
 Temperature vs. hot deformation ..... 8, 9  
 Temperature vs. sand control  
     properties ..... 261  
 Temperature vs. vapor pressure  
     and heat of evaporation ..... 262  
 Water needed to cool ..... 264  
 Western bentonite ..... 62  
 Western bentonite properties ..... 261
- Molding, Shell  
 Copper castings ..... 69-73  
 Process capability evaluation ..... 81-86  
 Survey of ..... 559-560
- Molds, Alumina  
 Sintered, investment casting  
     steels ..... 247-251

- Molds, Bar  
    Cast tensile, improved design .284-287  
Molds, Permanent (see also Die Casting)  
    And die life, nonferrous die  
        casting .....184-186  
Molds, sand  
    Green, gas pressures in .....361-368  
Molten  
    Aluminum, hydrogen release .301-304  
    Penetrating pressure vs. surface  
        tension .....2, 6  
Mulling  
    Molding sand .....33, 262-265, 283
- N**
- Nitrogen  
    Aluminum affinity to .....17  
    As a carbide stabilizer .....17  
    Content increased .....17  
        By ammonium compounds .....17  
        By ferrocyanides .....17  
    In cast iron .....17  
    Large additions, porosity .....17  
Pinholing effect .....34  
Retains eutectic carbide .....17  
Retains pearlite .....17  
Titanium affinity to .....17
- Nodular Iron  
    Analysis .....56  
    Austenitizing temperature .....156  
    Cementite .....151  
    Chemical composition, test irons ..152  
    Composition .....56  
    Ductility attainment .....151  
    Elongation graphite .....156  
    Eutectic fineness .....57  
    Ferrite formation vs. cooling  
        rates .....154, 155  
    Ferrite zones .....57  
Ferritization .....151-165  
    Of martensite .....156, 157, 158  
    Of pearlite .....155, 156  
Graphite growth rate .....57  
Heat treatments .....151, 152  
Impact ductility, martensite .....164  
Impact tests .....153, 162, 163  
    Values vs. unnotched bars .....163  
Interfacial energy .....58  
Isothermal growth .....57  
Isothermal transformation .....158-162  
    Evaluation, treated reheated .....163  
    For cooled specimens .....158, 159  
    For reheated  
        specimens .....160, 161, 162  
Magnesium vs. sulfur .....58  
Mechanical properties vs. per  
    cent ferrite .....155  
Normalizing treatment omission  
    effect .....164  
Per cent ferrite vs. time .....155  
Pinholing .....19, 24  
Properties, test irons .....153  
Quenching, fast .....56  
Quenching temperature vs.  
    properties obtained .....157  
Secondary graphite .....157  
Shotting .....56  
Slow cool .....57  
Solidification mechanism .....56  
Structural considerations .....56-58  
Surface energy .....58  
Tensile properties vs. heat  
    treatment .....153, 154  
Undercooling .....56, 58
- Nodules  
    Formation, nodular iron .....56-58  
Noise  
    Effects of .....325, 326
- Noise (continued)  
    Induced hearing loss .....324-326  
    What it is .....324, 325  
    Why be interested in .....325
- Nonferrous  
    Die casting, die and permanent  
        mold life .....184-186
- Nonferrous Metals  
    Alloys used, United Kingdom .....468
- Pattern  
    Casting machines .....469  
    Die and permanent mold casting,  
        United Kingdom .....466-479
- Dies .....469, 470  
Fettling and finishing .....472  
Industrial standards,  
    United Kingdom .....472  
Inspection and quality control .....473  
Mechanical handling .....471  
Mechanical properties, alloy .....467  
Melting equipment .....468  
Standard aluminum alloy .....467, 468  
Standard copper alloy .....468, 473  
Standard Magnesium alloy .....468, 472  
Standard zinc alloy .....468, 473  
Surface treatments .....473, 474  
Tensile and impact properties .476-479  
Variation of properties with  
    temperature .....477
- Novolak  
    And quartz, adhesion between,  
        gases effect on .....288-294
- Nuclear Reactor Castings  
    Cores .....211  
    Hexagonal castings .....212  
    Melting and molding .....210, 211  
    Mold design .....210  
    Radiator type, fuel elements .210-212
- O**
- Olivine  
    Accurate castings from .....299, 300  
    Aggregate, industrial applica-  
        tions .....295-300  
    Gray iron applications .....297, 298  
    Gray iron mixtures .....298  
    High manganese-steel applica-  
        tions .....298, 299  
    Nonferrous applications .....296  
    Nonferrous sand formulations .....296  
    Prior studies of .....295, 296  
    Shell-molding applications .....297  
    Shell-molding mixture .....297  
    Steel applications .....298  
    Steel mixtures, green sand .....298  
    Thermal properties .....296
- Oxygen  
    Chill depth, effect on .....18  
    Content increase .....17  
    In cast iron .....17  
    Increase in ladle .....17  
    Increase in low silicon iron .....17  
    Stabilizing effect .....17, 18  
    Vs. annealability .....18
- P**
- Packing  
    Of small particles, theories .....36-39  
    Particle, principles and  
        limitations .....553-555
- Particles  
    Packing, principles and  
        limitations .....553-555  
    Small, packing theories .....36-39
- Pattern  
    Equipment, foundry .....556-558  
    Equipment, shell mold, gating  
        and risering .....312-314  
    Margin of safety .....557
- Pattern (continued)  
    Plastics, a little knowledge of .197-198  
    Shell mold, and core boxes, con-  
        struction .....495-496  
    Standards .....556-558  
    Wear and construction, plastic  
        core boxes and .....569-570
- Pattermakers  
    Common problems of .....36-39  
    Engineering problems of .....585  
    How to help sell castings .....583-586  
    Market factors .....583  
    Pattern engineer and  
        duties .....584, 585-586
- Pearlite  
    And ferrite formation, cast  
        iron .....526-532
- Pearlitic Malleable  
    Air quench .....13-14  
    And standard, heat treatment vs.  
        quench and temper .....507-512
- Austenitizing increases  
    hardenability .....12  
Chemical composition .....12  
End quench .....12-16  
End quench graphs .....13-16  
Hardenability .....12-16  
Hardenability tests .....12  
Heat treatment .....12  
Liquid quench .....13, 14  
Machinability .....12  
Matrix hardness .....15  
Normal hardness range .....16  
Quench hardening .....12  
Rockwell hardness .....12-15
- Penetration, Metal  
    Literature review of .....1-6
- Permanent Mold  
    And die casting, aluminum  
        melting practice .....533-543  
    And die casting, nonferrous  
        metals .....466-479  
    And die life, nonferrous  
        casting .....184-186
- Pinholing  
    Additions effect .....27  
    Aluminum effect .....20, 23, 24, 25  
    Appearance of .....19  
    Aspiration type .....34  
        Gating against .....34  
    Causes .....31  
    Evolution type .....34, 35  
    Ferrosilicon effect .....24, 25  
    Hydrogen content effect .....26  
    In white iron castings .....31-35  
    Isolated type .....35  
    Magnesium effect .....24, 26  
    Manganese effect .....20, 22  
    Pouring temperature effect .....28  
    Prevention of .....19  
    Reaction type .....31, 32, 33  
    Titanium effect .....21, 23, 26, 27
- Plastic  
    A little knowledge of .....197-198  
    Early difficulties .....197  
Patterns and core boxes,  
    construction and wear .....569-570
- Specification problems .....198
- Surface coat, pattern .....569
- Uses other than patterns .....198
- Upkeep, patterns and core boxes .....570
- Versatility and workability .....197
- Porosity  
    85-5-5 bronze, foundry variables  
        effect .....391-396
- Press Forging  
    Aluminum alloys .....105
- Pressure  
    Gas, in green sand molds .....361-368

Pressure (continued)	
Increase promotes metal penetration .....	5
Solidification vs. microporosity, aluminum alloys .....	129-134
Prevention	
By the ounce .....	433-438
Establishing an effective maintenance program .....	439-445
Foundry preventive maintenance .....	446-451
Process	
Calcium carbide injection .....	327-335
Capability, shell molding, evaluation .....	81-86
Carbon dioxide, sodium silicates for .....	315-323
Processing	
And sieve ratios, strong molding sands .....	278-283
Properties	
And aging practice, aluminum alloy X357 .....	480-483
Bonding, bentonites, heat effect .....	305-311
High temperature, shell molds .....	484-494
Mechanical, aluminum castings .....	178
Mechanical, cast steel, vanadium effect .....	425-432
Nodular iron .....	153, 154
Tensile vs. heat treatment .....	153, 154
Press forged magnesium castings .....	111
Tensile, AZ-63 magnesium alloy .....	409-414
Purchase Specifications	
Bentonite .....	127, 128
Cold set oil .....	126, 127
Core oil .....	126
Corn cereal .....	126
Inspection program .....	125
Liquid phenolic plastic .....	126
Shell mold and core sand binders .....	125-128
Tests and equipment used .....	125
<b>Q</b>	
Quench Hardening, Pearlitic malleable iron .....	12
<b>R</b>	
Rammed	
Graphitic mold materials, titanium castings .....	135-142
Ramming	
Vs. penetrating pressure .....	3
Reaction	
Iron-silica interface, atmosphere and temperature effect .....	452-458
Pinholes, white iron castings .....	31-33
Reactive Metal Casting	
Alloy casting effects .....	258, 259
Arc-current variation effect .....	328
Carbon analysis .....	360
Consumable-electrode arc furnace .....	354, 355, 358, 360
Corrosion rates, zircaloy .....	357
Gas porosity .....	257
Hafnium .....	356
Heat distribution and metal yield .....	358, 359
Heat loss, arc operation .....	359, 360
Machined graphite molds .....	355, 359
Method for .....	354, 355
Problems .....	257-260
Process variables .....	357
Sales problem .....	259, 260

Reactive Metal Casting (continued)	
Scrap utilization .....	259
Shrinkage and warping in baking molds .....	259
Spin casting .....	356
Technology for .....	354-360
Temperature controlling .....	257
Temperature, poured metal .....	358, 359
Thermopile device .....	257
Titanium .....	355, 356, 357
Vacuum-arc furnace .....	257
Variable alloy effect .....	358, 359
Variable ladle size effect .....	358, 359
Variable pressure effect .....	358
Variables vs. temperature of melt .....	257
Zircaloy .....	356, 357
Zirconium .....	357
Reduction	
Of silica, large shell molds .....	459-465
Refractory	
Cupola, lining contour .....	117, 118
Electric furnace, shell cooling techniques .....	46-48
Rigging	
Design, magnesium castings .....	241-246
Ring Coolers	
Electric furnace .....	46-48
Risering	
And gating, shell mold pattern equipment .....	312-314
Gray iron .....	49-55
And solidification .....	369-379
Location .....	53
Neck size selection .....	53, 54
Recommendations .....	53, 54
Size selection .....	51, 52
<b>S</b>	
Sand (see also Molding Sand)	
Aluminum Castings .....	240
Bentonite additions vs. hot deformation .....	9
Base exchange capacity .....	305
Heat effect on bonding .....	305
Castings, aluminum .....	283
Aluminum-copper .....	96
Controlled heat transfer .....	177
Magnesium alloy .....	336
Compaction .....	36, 421, 553
Cores, CO <sub>2</sub> .....	252
Dry and green, effect on risering .....	50
Dry strength .....	59
Fire clay bonded .....	7
Grain fractions, density, sieve analysis .....	40
Grains, lose, pinholing .....	35
Green, gas pressures in molds .....	361
Green strength .....	59
Hot compressive strength .....	8
Hot deformation .....	7
Hot deformation vs. fire clay additions .....	10
Hot, problem of .....	261
Hot toughness .....	7
Hydrogen pickup from .....	19
Iron interface, freezing graphs .....	214
Magnesium foundry, induction melting .....	87
Metal penetration in, surface tension .....	290
Mixes, for steel casting .....	7
Mixtures, austenitic steels .....	520
Moisture, hot deformation rate .....	9
Mold	
Metal penetration in .....	1
Metal reaction .....	452
Ramming effect .....	3
Sand (continued)	
Surface behavior .....	74
Mulling of .....	33, 262, 283
Olivine, industrial applications .....	295
Properties, gun-metal castings .....	235
Shell mold, cold-coated mixes .....	492
Dry mixes .....	489
Mixtures .....	559
Size distribution .....	461
Uses, for tests .....	484
Sieve ratios for strong .....	278
Sodium silicate, for the CO <sub>2</sub> process .....	315
Sodium silicate, hardening .....	91
Ventilation, bin and mixer .....	419
Voids, metal penetration .....	6
Sand, Compaction	
Small particles, theories .....	38-39
Sand Grain Fractions	
Compacting samples, method of .....	41, 42
Densities vs. jolting energy .....	43, 44
Density .....	40-45
Graphs, sand fractions .....	42, 43
Michigan bank .....	42
Michigan city .....	43
Ottawa .....	42
Wisconsin bank .....	43
Wisconsin silica .....	42
Iron determination .....	43
Microscopic examination .....	43
Ramming effects .....	42, 44
Sieve analysis .....	40, 41
Sieve fractions preparation .....	40, 42
Test sands used .....	40
Sand Grains	
Loose, pinholing .....	35
Sand Mixes	
Large steel castings .....	7
Sand Mold	
Green, gas pressures in .....	361-368
Hydrogen pickup, green and dry sand .....	19
Scrap	
Cupola operation, effect on .....	397
Metal charges used .....	397
Size and weight effect, tapping temperature and coke cost .....	398
Size effect, cupola tapping temperature .....	397-398
Types of, used .....	397, 398
Sea Coal	
Additions vs. hot deformation .....	10
Shell Mold	
Basic materials used .....	495
Casting defects .....	488
Casting diameter measurement .....	487
Cavities inserted .....	496
Cold-coated mixes .....	488
Cope and drag swell measurement .....	485, 487
Defect formation, effect on .....	461
Designing of gating .....	313
Direct and indirect pressure-type gates .....	314
Dry shell mixes .....	486, 487
High temperature expansion .....	488
High temperature tests .....	486
Metal poured for tests .....	485
Mixing procedure .....	484
Mold composition, effect .....	462
Mold design, for tests .....	459
Pattern equipment, gating and risering .....	312-314
Patterns and core boxes, construction of .....	495-496
Placing gates and risers .....	314
Planning gating system .....	312, 313

- Shell Mold (continued)**
- Plate defect ..... 489
  - Pouring ..... 485
  - Pressure-type gates ..... 313, 314
  - Primary steps to consider in construction ..... 495
  - Problems of ..... 312
  - Rattail defect ..... 489
  - Reaction mechanisms ..... 462, 463
  - Resins used ..... 484
  - Sands used ..... 484, 486
  - Section size, effect ..... 460, 461
  - Shell bonding ..... 485
  - Shell making ..... 484
  - Shell tensile strength ..... 486
  - Silicon-oxygen reactions ..... 462
  - Size distribution, sand used ..... 461
  - Sprue and runner basins ..... 313
  - Standardization of parts ..... 496
  - Strengths of shell mixes ..... 486
  - Surface imperfections in large ..... 459
  - Temperature, effect ..... 460
  - Test data and results, cold-coated mixes ..... 492-494
  - Test data and results, dry mixes ..... 489-492
  - Test pattern ..... 484
  - Use of gates ..... 313
- Shell Molding**
- Advantages ..... 82
  - Automatic transmission casting ..... 81, 82
  - Average deviations ..... 85
  - Calcium carbonate effect ..... 405, 406
  - Calcium boride ..... 71
  - Composite molds ..... 407
  - Copper, deoxidation practice ..... 69-73
  - Deterrent to steel castings ..... 403
  - Differential case test ..... 83
  - Dimensional accuracy ..... 81
  - Dimensional control ..... 81
  - Dimensional variation ..... 559
  - Dissociation temperature, calcium carbonate ..... 406
  - Electrical conductivity ..... 70, 71, 72
  - Embrittlement, hydrogen ..... 69, 70
  - Enthalpy changes ..... 406
  - Equations for calculating deoxidation ..... 69
  - For steel castings ..... 403-408
  - Forsterite effect ..... 404
  - Histograms, distribution frequency ..... 84, 85
  - Hydrogen pickup ..... 72, 73
  - Hydrogen vs. copper oxide ..... 69, 72
  - Liquid bonding resin ..... 81, 82
  - Manganese dioxide effect ..... 405, 406
  - Molding practice ..... 70
  - Mold material coefficients ..... 405
  - Oxygen ..... 70
  - Pattern dimensions ..... 83
  - Problems, production ..... 560
  - Process, capability evaluation ..... 81-86
  - Quality control ..... 560
  - Reaction equilibrium, carbon and carbon dioxide ..... 406
  - Sand and sand-resin mixtures ..... 559-560
  - Shell core blowing ..... 84
  - Shell core dimensions ..... 85
  - Skip formation
  - Surface defect causes ..... 403, 404
  - Survey of ..... 559-560
  - Thermal conductivity, olivine ..... 405
  - Titanium effect on deoxidation ..... 71
  - Zircon effect ..... 404, 405
- Shrinkage**
- Distribution, gray iron ..... 371
- Silica**
- Reduction, large shell molds ..... 459-465
- Silica Flour**
- Bonded sands ..... 7
  - Eliminates metal penetration ..... 6
  - Hot deformation vs. ..... 10, 11
- Silicon**
- In pearlitic malleable iron ..... 16
  - Losses in cast iron ..... 17
  - Low, in cast iron ..... 17
  - Raises oxygen content ..... 17
  - of scrap effect, cupola tapping temperature ..... 397-398
- Sodium Silicate**
- Bonded sand, hardening ..... 91-95
  - Bonding characteristics ..... 318-319
  - Colloidal nature of ..... 316
  - Composition after gassing ..... 320
  - Composition of ..... 317
  - Compressive strength vs. gassing ..... 321
  - Concentration vs. viscosity ..... 316
  - Density vs. composition ..... 316
  - Dry strength ..... 322
  - For the carbon dioxide process ..... 315-322
  - Mixing order ..... 318
  - Mixing order vs. gassed strength ..... 318
  - Physical characteristics ..... 317
- Solidification**
- Mechanism, gray iron riser ..... 49, 50, 54
  - Pressure vs. microporosity, aluminum alloys ..... 129-134
  - Vs. interface temperature ..... 213-221
- Solution Treatment**
- Aluminum-copper alloys effect ..... 96-103
- Specifications**
- Purchasing steel mold and core sand binders ..... 125-128
  - Steel scrap, duplexing cupola white iron ..... 268-270
- Steel**
- Cast, effect of vanadium on mechanical properties ..... 425-432
  - Castings, factors affecting toughness ..... 344-348
  - Castings, resistance to abrasion ..... 187-196
  - Investment casting, sintered alumina molds ..... 247-251
  - Mold penetration depth ..... 4
  - Mold, purchase specifications ..... 125-128
- Steel Castings**
- Abrasive hardness influence ..... 195
  - Abrasive hardness vs. wear rates ..... 195
  - Acid or basic steel ..... 344, 345
  - Acid slag viscosity vs. metal quality ..... 346
  - Alloying elements effect ..... 191
  - Alloy recovery from slag ..... 346
  - Austenitic steels ..... 193, 194
  - Austenitizing temperature vs. wear rates ..... 190
  - Boil phase effect ..... 345
  - Calcium carbonate effect ..... 405, 406
  - Carbon content vs. abrasion resistance ..... 191
  - Carbon steel ..... 345
  - Composite shell molds for ..... 407
  - Deterrent to shell molding of ..... 403
  - Dissociation temperature, calcium carbonate ..... 406
  - Enthalpy changes, shell molding ..... 406
  - Factors affecting toughness ..... 344-348
  - Forsterite effect ..... 404
  - Hydrogen effect ..... 345, 346
  - In ball and rod mills ..... 188
- Steel Castings (continued)**
- Iron oxide in slag vs. metal quality ..... 346
  - Manganese dioxide effect ..... 405, 406
  - Martensitic steels vs. martensitic white irons ..... 192
  - Mold material coefficients ..... 405
  - Pearlitic steels ..... 192, 193
  - As-cast vs. normalized ..... 192
  - Carbon effect ..... 193
  - Hardness effect ..... 193
  - Pearlite and bainite ..... 193
  - Tempering effect ..... 193
  - Reaction equilibrium, carbon and carbon dioxide ..... 406
  - Reduction of area ..... 344-347
  - Resistance to high stress
    - abrasion ..... 187-196
    - Rockwell hardness ..... 188
    - Shell molding for ..... 403-408
    - Short-time wear test ..... 188
    - Skin formation ..... 405
    - Slag and temperature adjustment ..... 346
    - Slag-metal reactions ..... 347
    - Slag vs. metal quality ..... 348
    - Solidification equation ..... 405
    - Sulfur effect ..... 344, 345
    - Surface defect causes, shell molding ..... 403, 404
    - Tap-hole size vs. metal quality ..... 347
    - Tempering vs. abrasion resistance ..... 191
    - Tensile strength ..... 344
    - Thermal conductivity, olivine ..... 405
    - Time vs. wear testing materials ..... 188
    - Wear rates, liner steels ..... 189, 190
    - Zircon effect ..... 404, 405
- Steel Scrap**
- Cost vs. loss ..... 269
  - Loss reduction through control ..... 270
  - Melting loss due to scrap preparation ..... 269, 270
  - Raw material cost per ton ..... 269
  - Specifications, duplexing cupola white iron ..... 268-270
  - Steel melting scrap ..... 270
  - Undesirable, effects ..... 268, 269
- Structural**
- Considerations, nodular iron ..... 56-58
- Sulfur**
- Magnesium, nodular iron vs. ..... 58
- Surface Tension**
- Ammonia effect ..... 291-293
  - And contact angle, helium ..... 290, 291
  - Equations for calculating ..... 294
  - Liquid, measurement ..... 290, 291
  - Nitrogen effect ..... 291-293
  - Oxygen effect ..... 291, 292
  - Penetrating pressure vs. ..... 2
  - Water vapor effect ..... 291-293
- T**
- Temperature**
- And atmosphere effect, iron-silica interface reaction ..... 452-458
  - High and low, mechanical properties, cast steel, vanadium effect ..... 425-432
  - High, properties, shell molds ..... 484-494
  - Interface vs. solidification ..... 213-221
  - Metal, increase, lessens penetrating pressure ..... 5
  - Pouring, increases metal penetration ..... 1
  - Pouring, pinholing effect ..... 28
  - Tapping, coke needed to produce ..... 398

Témpérature (continued)	
Tapping, cupola, scrap size effect .....	397-398
Vs. hot deformation .....	8, 9
Vs. penetrating pressure .....	2
Tensile	
Cast bar molds, improved design .....	284-287
Properties, AZ-63 magnesium alloy .....	409-414
Tin	
Penetrating pressure vs. temperature .....	2
Rammung vs. penetrating pressure .....	3
Titanium Castings	
As-cast surfaces .....	228
Carbon contamination .....	225, 226
Chemical analysis, ingot .....	227, 228
Chemical reactivity .....	226
Consumable electrode-vacuum arc furnace .....	135
Difficulties with .....	225
Heat treatments .....	227
High strength, by induction melting .....	225-230
Knoop hardness vs. distance into metal .....	139, 141
Macroetch surface .....	228
Mechanical properties .....	228, 229
Melting process .....	226
Molds, graphitic	
Absolute permeability,* equation .....	136
Baked compressive strength vs. per cent water .....	138
Compressive strength .....	136, 137, 141
Fired compressive strength vs. mold pressure .....	138
Titanium Castings (continued)	
Green compressive strength vs. per cent water .....	138
Material composition .....	136
Penetration .....	137, 140
Permeability .....	136, 138, 141
Permeability vs. per cent water .....	139
Preparation procedure .....	142
Rammed material for .....	135-142
Refractories .....	135
Sieve analysis, electric furnace graphite .....	135
Optimum strength-ductility .....	230
Shrinkage .....	136, 137
Surface contamination .....	137, 139
Surface evaluation .....	136, 137
Thermal conductivity .....	137, 139, 140
Toughness	
Factors affecting, mild steel castings .....	344-348
Treatment	
Chemical, copper alloys .....	271-277
Heat, vs. tensile properties, nodular iron .....	153, 154
U	
Undercooled Graphite	
Formation .....	18, 561-568
V	
Vacuum	
Die casting, progress in .....	199-202
Vanadium	
Mechanical properties, effect on cast steel .....	425-432
Voids	
Determine penetrating pressure .....	6
Size, pressure and temperature work together .....	6
W	
Washes	
Alleviate metal penetration .....	4
Detergents make effective .....	4
Silica flour effect .....	4
Zircon flour effect .....	4
Wear	
And buildup, material, dust piping to prevent .....	418-420
White iron	
Duplexing, cupola, steel scrap specifications .....	268-270
Pinholing defects, causes and types of .....	31-35
Wood Flour	
Additions vs. hot deformation .....	10, 11
Work Sampling	
Acceptable tolerances in .....	580
Confidence levels of .....	579-580
Day-to-day variation in .....	579
Nomographs for .....	580, 581
Observation interval for .....	579
Step-by-step procedure in .....	581-582
Technique, practical application of .....	578-582
Theory of random sampling in .....	578-579
Z	
Zinc	
-Aluminum-Magnesium casting alloy .....	222-224

